

Annex A to Sections L&M F04701-02-R-0500

NPOESS Work Breakdown Structure (WBS)

**NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL
SATELLITE SYSTEM (NPOESS)**

1 FEB 2002

Purpose

The following is a Work Breakdown Structure (WBS) for the entire NPOESS program. It covers all efforts potentially required to meet the program objectives throughout the program lifecycle. The lifecycle for the NPOESS program begins at Milestone I, March 1997 and runs through the end of the mission life as defined in the Integrated Operational Requirements Document (IORD) and the Technical Requirements Document (TRD). This approximately 20 year period, from 1997 to 2018, includes effort performed on multiple contracts. Each contract contributes to one or more parts of the overall program WBS. Under the Shared System Performance Responsibility (SSPR) concept, the contract includes effort in most of these WBS elements. To simplify accounting, two elements have been created which specifically exclude contractor effort. These are the Launch Segment, WBS 1.1, and the Government Program Office, WBS 1.15. SSPR contractor contributions to launch support are included primarily in the Flight Support Operations and Services (FSOS), WBS 1.10. The remaining elements describe additional efforts that may be required to achieve the NPOESS program objectives.

The WBS allows the Government and offeror to organize their estimates under a common structure. When extending the WBS into a Contract WBS (CWBS), the SSPR effort shall be allocated in accordance with the definitions contained herein. It is not required that the CWBS include the full range of efforts described in the definitions nor that it extend from all WBS elements. Depending on the system architecture proposed, some elements may not be necessary to achieve program objectives. Similarly, elements may contain effort that will be provided by the Government. The CWBS shall extend only below the provided elements. Equipment, services, support, or other resources exclusively provided by the Government are labeled Government Furnished (GF).

Work Breakdown Structure (WBS)*

- 1 National Polar-orbiting Operational Environmental Satellite System (NPOESS)
 - 1.1 Launch Vehicle Segment (GF)
 - 1.1.1 Launch Vehicle Services (GF)
 - 1.1.2 Mission Unique Integration (GF)
 - 1.2 Space Segment
 - 1.2.1 Satellite Assembly, Integration & Test
 - 1.2.2 Spacecraft
 - 1.2.3 Payload
 - 1.2.3.1 VIIRS
 - 1.2.3.2 CMIS
 - 1.2.3.3 CrIS
 - 1.2.3.4 ATMS
 - 1.2.3.5 OMPS
 - 1.2.3.6 GPSOS
 - 1.2.3.7 ADCS (GF)
 - 1.2.3.8 SARSAT (GF)
 - 1.2.3.n Other Payloads (*SESS, TSIS, ERBS, Radar Altimeter, Survivability Sensor, and APS, etc.*)
 - 1.3 Command, Control & Communications Segment (C3S)
 - 1.4 Interface Data Processing Segment (IDPS)
 - 1.5 Systems Engineering/Program Management (SE/PM) & Data
 - 1.6 System Test & Evaluation
 - 1.7 Systems Training
 - 1.8 Peculiar Support Equipment (PSE)
 - 1.9 Common Support Equipment (CSE)
 - 1.10 Flight Support Operations & Services (FSOS)
 - 1.10.1 Mission Unique Integration
 - 1.10.2 Mate, Checkout, and Launch
 - 1.10.3 On-Orbit Support and Operations
 - 1.11 Storage
 - 1.12 Industrial Facilities
 - 1.13 Initial Spares & Repair Parts
 - 1.14 Operations & Support (O&S)
 - 1.15 U.S. Government Program Office (GPO) Support (GF)
 - 1.16 Field Terminal Segment

*(Note: An alternative numbering system by Offeror is authorized.)

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1 National Polar-orbiting Operational Environmental Satellite System (NPOESS)

This refers to the hardware, software, data, services, and facilities required to attain and/or maintain NPOESS. NPOESS includes launch vehicles, satellites, communications, command and control, processing facilities and equipment, mission integration, and other mission equipment and personnel necessary to provide and sustain an operational capability in space. Specifically, the NPOESS is a joint agency program combining the capabilities of the DoD DMSP and DOC POES operational space systems into a single converged system. The program will be required to provide, for approximately a decade, a remote sensing capability to acquire, receive (at ground terminals), and disseminate (to processing centers), global and regional data. These data include cloud cover imagery as well as other specialized meteorological, climatic, terrestrial, oceanographic, and solar-geophysical data. The goal of the converged program is to reduce the cost of acquiring and operating the U.S. polar-orbiting environmental satellite systems, while continuing to satisfy United States operational civil and national security requirements. It is anticipated that operational data will be collected with a variety of sensors to provide both civil and military environmental data.

1.1 Launch Segment (Government Furnished)

This segment includes all costs to procure the launch vehicle, integrate the satellite (s) with a launch vehicle, and launch the satellite into the required orbit. NPOESS satellites are designed to be compatible with the Evolved Expendable Launch Vehicle. This segment also includes costs for launch services which include the organization, maintenance and management of launch vehicle facilities and mission equipment, launch base support and flight support operation for the launch vehicle. Other flight support operation costs are assigned under WBS element 1.10. Flight Support Operations & Services.

1.1.1 Launch Vehicle Services (Government Furnished)

This element refers to the materials and services provided by the Launch Vehicle Contractor (LVC) that are needed to place the NPOESS satellite into orbit using the MLV class of the EELV boosters. Launch vehicle services includes all processing operations, standard payload integration, and launch. Standard payload integration is defined per the EELV Program Standard Interface Specification and provides a pre-defined envelope of basic interfaces and services.

1.1.2 Mission Unique Integration (Government Furnished)

This element refers to the services provided by the LVC to accomplish first launch LV/SV mission unique integration (MUI). MUI normally occurs only on the first launch but may be required for subsequent launches due to mission, spacecraft, or payload changes that could impact the booster, payload interface, or launch site facilities. The scope varies greatly and can impact any or all LV systems: structural, electrical, or mechanical elements.

1.2 Space Segment

This Segment includes recurring and nonrecurring costs of all components for risk reduction, design, qualification, and production of the completed satellite ready for shipment to launch site or storage. The major components of the space segment are satellite integration, assembly & test, spacecraft bus, IPO-developed sensors, leveraged payloads, and Government furnished (GF) payloads. The functions of the space segment are to sense and collect data, receive and execute commands from the C3S, transmit stored mission data to the C3S, and transmit high rate and low rate data to external field terminal collection platforms.

1.2.1 Satellite Integration, Assembly, and Test (IAT)

This element refers to all satellite efforts associated with the design, development, and production of mating surfaces, structures, equipment, parts, materials, and software required to assemble associated level 3 WBS elements into level 2 mission equipment (hardware/software) as a whole and not directly part of any other individual level 3 element. IAT includes all efforts associated with the following: (a) The development of engineering layouts and determination of overall design characteristics; (b) The set up, conduct and review of testing assembled components or subsystems prior to installation; (c) The detailed production design, producibility engineering planning (PEP), and manufacturing process capability, including the process design development and demonstration effort to achieve compatibility with engineering requirements and the ability to produce economically and with consistent quality; (d) Inspection activities related to receiving, factory and vendor liaison; (e) Design maintenance effort; (f) Quality planning and control; (g) Tooling (initial production facilities, factory support equipment) including its planning, design and fabrication; (h) Administrative engineering; (i) The joining or mating and final assembly of level 3 equipment elements to form a complete prime mission equipment when the element assembly is performed at the manufacturing facility; (j) Integration of software (including the loading and verification of firmware); and, (k) The conduct of production acceptance testing. This IAT element also includes all spacecraft testing chambers (vacuum, shock, thermal, etc.) and costs associated with systems engineering activities related to the integration of spacecraft bus subsystems. The IAT element excludes all system engineering/-program management/data (SE/PM/Data) and system test and evaluation (ST&E) associated with the overall system.

1.2.2 Spacecraft

The spacecraft element refers to the principle operating space vehicle which serves as a housing or platform for carrying a payload and other mission-oriented equipment in space. This element includes, for example, structure, communications, power, attitude determination and control, and other equipment characteristic of a spacecraft bus. It also includes all design, development, production, and assembly efforts to provide the spacecraft bus as an entity.

1.2.3 Payload

The payload element refers to that equipment provided for special purposes in addition to the normal equipment integral to the spacecraft bus. It includes, for example, the sensor suite placed on board the vehicle, communications, instrumentation, telemetry equipment and other mechanisms that are specifically mission-oriented to collect data for future planning and projection purposes. Typical hardware normally includes, for example, associated multiple detector elements, calibration devices, sensor system electronics, sensor housing/equipment, and other sensor subsystems. This element includes software intrinsic to specific sensors, along with the design, development, production, and assembly efforts for each sensor. This element also includes costs associated with systems engineering efforts to integrate payload sensors in regard to field of vision analyses, bus impacts, and electromagnetic interference. All effort directly associated with the integration, assembly, test and checkout of these elements into the space segment is excluded.

1.2.3.1 Visible Infrared Imager Radiometer Suite (VIIRS)

This element refers to the design, development, and production of all hardware and flight software components of the VIIRS to include any engineering development, protoflight, and production units. It includes the design, fabrication, assembly, and test of individual hardware and flight software components and/or modules plus the integration, assembly and test efforts required to produce fully integrated and tested sensor suite units. All necessary efforts to develop, produce, and test the required sensor algorithms are also included along with the activities associated with all required special test equipment, special tooling, production planning, systems engineering, and program management.

1.2.3.2 Conical Microwave Imager Sounder (CMIS)

This element refers to the design, development, and production of all hardware and flight software components for complete units of the CMIS to include any engineering development, protoflight, and production units. It includes the design, fabrication, assembly, and test of individual hardware and flight software components and/or modules plus the integration, assembly and test efforts required to produce fully integrated and tested sensor suite units. All necessary efforts to develop, produce, and test the required sensor algorithms are also included along with the activities associated with all required special test equipment, special tooling, production planning, systems engineering, and program management.

1.2.3.3 Cross-Track IR Sounder (CrIS)

This element refers to the design, development, and production of all hardware and flight software components for complete units of the CrIS to include any engineering development, protoflight, and production units. It includes the design, fabrication, assembly, and test of individual hardware and flight software components and/or modules plus the integration, assembly and test efforts required to produce fully

integrated and tested sensor suite units. All necessary efforts to develop, produce, and test the required sensor algorithms are also included along with the activities associated with all required special test equipment, special tooling, production planning, systems engineering, and program management.

1.2.3.4 Advanced Technology Microwave Sounder (ATMS)

This element refers to the design, development, and production of all hardware and flight software components for complete units of the ATMS to include any engineering development, protoflight, and production units. Design and development specifically refers to unique efforts that may be required for Flight Unit #2 and beyond. Design, development and production of Flight Unit #1 are Government Furnished (Flight Unit 1 is the NPP instrument). It includes the design, fabrication, assembly, and test of individual hardware and flight software components and/or modules plus the integration, assembly and test efforts required to produce fully integrated and tested sensor suite units. All necessary efforts to develop, produce, and test the required sensor algorithms are also included along with the activities associated with all required special test equipment, special tooling, production planning, systems engineering, and program management.

1.2.3.5 Ozone Mapper and Profiler Suite (OMPS)

This element refers to the design, development, and production of all hardware and flight software components for complete units of the OMPS to include any engineering development, protoflight, and production units. It includes the design, fabrication, assembly, and test of individual hardware and flight software components and/or modules plus the integration, assembly and test efforts required to produce fully integrated and tested sensor suite units. All necessary efforts to develop, produce, and test the required sensor algorithms are also included along with the activities associated with all required special test equipment, special tooling, production planning, systems engineering, and program management.

1.2.3.6 Global Positioning System Occultation Sensor (GPSOS)

This element refers to the design, development, and production of all hardware and flight software components for complete units of the GPSOS to include any engineering development, protoflight, and production units. It includes the design, fabrication, assembly, and test of individual hardware and flight software components and/or modules plus the integration, assembly and test efforts required to produce fully integrated and tested sensor suite units. All necessary efforts to develop, produce, and test the required sensor algorithms are also included along with the activities associated with all required special test equipment, special tooling, production planning, systems engineering, and program management.

1.2.3.7 ADCS (Government Furnished)

This element is the Advanced Data Collection System (ADCS) transponder (e.g., ARGOS-3) which is provided as GF (with the exception of the antennas and cables).

The ARGOS system is an international surface data collection system that is managed by France.

1.2.3.8 SARSAT (Government Furnished)

This element is the Search and Rescue Satellite Aided Tracking (SARSAT) instruments that are provided as GF (with the exception of the antennas). The SARSAT system is part of the COSPAS-SARSAT international search and rescue system that is managed by representatives of the U.S., Canada, France, and Russia. The SARSAT beacons and LUTs will be supplied, implemented, operated, and maintained by local authorities.

1.2.3.n Other Payloads (SESS, TSIS, ERBS, Radar Altimeter, Survivability Sensor, and APS, etc.)

This element refers to the design, development, and production of all hardware and flight software components for complete units of any additional payloads that will be procured and or modified to satisfy NPOESS requirements to include any engineering development, protoflight, and production units. It includes the design, fabrication, assembly, and test of individual hardware and flight software components and/or modules plus the integration, assembly and test efforts required to produce fully integrated and tested sensor suite units. All necessary efforts to develop, produce, and test the required sensor algorithms are also included along with the activities associated with all required special test equipment, special tooling, production planning, systems engineering, and program management.

1.3 Command, Control, and Communications Segment (C3S)

Includes all hardware and software required for command and control, data routing and retrieval, satellite simulation and the C3S level integration, assembly, test, and configuration management. The functions of the C3S are to transfer commands from the mission management centers to the satellite; to receive telemetry data from the satellite and transfer such data to the mission management centers; to receive stored mission data from the satellite and transfer it to the IDPS; to provide voice communications between the elements of the C3S; and to provide a mechanism for on-orbit satellite test and evaluation. The C3S includes costs for the ground hardware/software equipment used to communicate between control and tracking facilities, monitor the health and status of satellites, command the satellite's hardware and adjust the satellite's orbit as required for health or mission purposes and provide for overall enterprise management. Recurring costs to operate and sustain the C3S are included in WBS 1.14 Operations & Support. Also includes the Flight Vehicle Simulator consisting of hardware and software elements that provide a high-fidelity dynamic simulation of all spacecraft subsystems and mission sensors.

1.4 Interface Data Processing Segment (IDPS)

Provides for processing of mission data. The functions of the IDPS are to ingest data transferred from the C3S (global, multispectral data and other specialized meteorological, oceanographic and solar-geophysical data); process these data into

environmental products, and make them available to national environmental and weather centers. IDPS includes costs for the ground hardware/software equipment used for data processing along with segment level integration, assembly, test, configuration management and algorithm development capability. Processing for field terminals is covered in WBS 1.16. Recurring costs to operate and sustain the IDPS are included in WBS 1.14 Operations & Support.

1.5 System Engineering/Program Management/Data Segment

This segment is defined as the systems engineering, system integration, configuration management and business management of all segments of the NPOESS system. SE/PM encompasses the overall planning, directing, and controlling of the definition, development, and production of the NPOESS system and major segments, including logistics engineering and management. SE/PM/Data effort that can be associated specifically with equipment (hardware/software) elements, e.g., spacecraft bus, payloads, etc., is excluded. This segment also includes costs associated with the contractor production of government-required documentation. Excludes Government Program Office costs, which are included in WBS 1.15.

1.6 Systems Test and Evaluation

This element includes Developmental Test and Evaluation (DT&E), Operational Test and Evaluation (OT&E), and Combined Test and Evaluation. DT&E is conducted to demonstrate that the engineering design and development process is complete, that design risks have been minimized, and that the integrity of the segment interfaces and the overall system design and performance is ensured. The tests will include both functional and environmental tests. The purpose of OT&E is to verify that NPOESS is operationally effective and suitable. OT&E is conducted by AFOTEC and supported by the EMD/Production contractor. OT&E will ensure that NPOESS will meet or exceed operational performance requirements. The Initial Operational Test and Evaluation (IOT&E) will assess the operational effectiveness and suitability of the NPOESS and provide feedback on operational issues and capabilities. OT&E will be conducted incrementally to provide an early assessment of operational capability. Combined Testing is defined as simultaneous testing conducted by the development and operational testers when cost, schedule, or test item availability dictates that they must share test facilities, resources, and data. NPOESS will utilize combined testing to the fullest extent possible in order to reduce costs and the time required to conduct all necessary testing. Events, staffing and activities for all segments are defined in the NPOESS TEMP.

1.7 Systems Training

System training is defined as the training services, devices, accessories, aids, equipment, and parts used to facilitate instruction through which personnel will acquire sufficient concepts and skills to operate and maintain the system with maximum efficiency. System Training includes all effort associated with the design, development, and production of deliverable training equipment as well as the execution of initial training services. System Training excludes the overall planning, management, and task analysis function inherent in WBS 1.5 SE/PM/Data.

1.8 Peculiar Support Equipment (PSE)

Includes the design, development, and production of those items and associated software required to support and maintain the NPOESS while not directly engaged in the performance of its mission, and which have application peculiar to a given material item. PSE includes, for example, vehicles, equipment, tools, etc., used to fuel, service, transport, hoist, repair, overhaul, assemble, disassemble, test, inspect, or otherwise maintain the mission equipment. It also includes any production of duplicate or modified factory test or tooling equipment delivered to the USG for use in maintaining the system (factory test and tooling equipment initially used by the contractor in the production process but subsequently delivered to the USG will be included as cost of the item produced). It also includes any additional equipment or software that will be required to maintain or modify the software portions of the system. PSE specifically excludes the overall planning, management and task analysis functions inherent in the work breakdown structure element systems engineering /program management, and the common support equipment presently in the USG inventory or commercially common within industry which is bought by the using activity and not by the program office.

1.9 Common Support Equipment (CSE)

Refers to those items required to support and maintain the system or portions of the system while not directly engaged in the performance of its mission, and which are presently in inventory for the support of other systems. CSE includes all efforts required to assure the availability of this equipment for support of the particular material item. CSE also includes the acquisition of additional quantities of this equipment if caused by the introduction of the material item into operational service.

1.10 Flight Support Operations & Service (FSOS)

The flight support operations element consists of mission unique integration, LV/SV mate, processing, launch, and initial on-orbit checkout. The scope includes SV personnel and material at the launch site and satellite operations center(s) supporting launch processing and post-launch orbit insertion systems testing. The flight operations and orbital checkout support element refers to the personnel and material required to operate individual mission control centers and to perform ground command and control associated with the spacecraft bus and payloads during the launch phase. It also includes effort and materials to conduct equipment receiving and checkout at the launch site, pre- and post-flight data reduction and analysis, any pre launch flight control/mission control planning for the spacecraft bus and payloads. In addition, this element covers those required activities performed at the primary contractor facility, the satellite operations center and other locations as assigned to process the NPOESS spacecraft bus and payloads either from factory shipment or removal from storage to launch. The launch support period begins at either the spacecraft's departure from the contractor facility, or its removal from storage, goes through lift off and ends with the completion of post launch activities and early orbit support. This segment also includes the preflight operations and services both subsequent to production and/or storage and during launch of the spacecraft bus and payloads plus launch support element, e.g.,

payload processing facilities, real property installed equipment and aerospace ground equipment not included in WBS 1.1 Launch Segment. This element excludes calibration/validation, which will be included in WBS 1.6.

1.10.1 Mission Unique Integration

This element refers to functions performed by the SVC to accomplish LV/SV mission unique integration (MUI). MUI normally occurs only on the first launch but may be required for subsequent launches due to mission, spacecraft, or payload changes that could impact the booster, payload interface, or launch site facilities. The scope varies greatly and can impact any or all SV and/or LV systems.

1.10.2 Mate, Checkout & Launch

This element refers to the standard recurring SV receipt, inspection, test, integration and mate, integrated testing, and launch support services performed by the Satellite Vehicle Contractor(s) (SVC) at the launch site.

1.10.3 On-orbit Support

The flight support operations and orbital checkout refers to the personnel and material at the primary contractor facility, the satellite operations center and other locations required to perform ground command and control associated with the spacecraft bus and payloads during the launch processing and post-launch orbit insertion. It excludes pre-launch and launch activities at the launch site. Flight support operations begins with the spacecraft's departure from the contractor facility and ends after the spacecraft and payloads have been verified operational ready.

1.11 Storage

Storage refers to those activities required to hold portions of the spacecraft bus and payloads while awaiting use of the system. These periods of holding include those resulting from schedule changes and/or technical problems exogenous to the portion of the spacecraft bus and payloads being stored, prepared for storage, or recovered from storage. This item also includes relocating the spacecraft bus and payloads from one storage area to another storage area when necessitated by mission requirements.

1.12 Industrial Facilities

Refers to the construction, conversion or expansion of industrial facilities for production, inventory and contractor depot maintenance required when that service is for the specific system; real estate and preparation of system peculiar industrial facilities for production, inventory, depot maintenance and other related activities; production equipment acquisition, modernization or transferal of equipment for the particular system (pertains to government owned and leased equipment under facilities contract). This element also includes industrial facilities for hazardous waste management to satisfy environmental standards.

1.13 Initial Spares & Repair Parts

This segment includes the purchase of components, assemblies and subassemblies used for initial replacement purposes in the Space, C3S, and IDPS equipment end items. It also includes repairable spares and spare parts required as initial stock to support and maintain the fielded system or systems during the first year **after IOC**. It does not include the purchase of entire instruments, sensor suites or other major subsystems.

1.14 Operations & Support

Includes the recurring costs for the personnel, material and services required to operate and maintain all operational segments of the NPOESS system. The following phases apply to O&S for all segments:

Phase 1 – Initial contractor O&S from completion of segment testing for NPP components through IOC.

Phase 2 – Government and Contractor O&S not earlier than IOC through the end of the program.

1.15 US Government Program Office (Government Furnished)

This element includes the NPOESS Integrated Program Office under the direction of a System Program Director (SPD) that will carry out the program or project. This involves the business and administrative planning, organizing, directing, coordinating, controlling, and approval actions designated to accomplish overall program objectives.

1.16 Field Terminal Segment

This element provides for Raw Data Record (RDR) and Environmental Data Record (EDR) processing at High Rate Data and Low Rate Data User Field Terminals. The functions of the Field Terminal Segment are (1) to accept Intermediate Frequency (IF) data from the User Field Terminal Antenna and Radio Frequency (RF) equipment, (2) to process these data into RDRs and EDRs, and (3) to transfer the processed data to the User Field Terminal. NPOESS field terminals will be located around the world in fixed and mobile configurations. A notional field terminal is composed of an antenna with associated RF equipment, a receiver, a front-end processor (which will run the NPOESS provided FTS software), and a database management system; all of these functions are similar to those of the Central user element. The Field Terminal Segment includes costs for field terminal unique software only. NPOESS will develop hardware requirement and interface specifications, but equipment purchase is the responsibility of the user. Recurring software maintenance costs are included in WBS 1.14 Operations & Support. First time training on each of the terminal types is included in WBS 1.7, System Training.